

# LOWER EXTREMITIES

## PATHOLOGY

### 1.) Congenital Clubfoot

- Talipes equinovarus
- Abnormal twisting of the foot usually inward & downward

### 2.) Pott's Fx

- Avulsion fx of the medial malleolus with loss of the ankle mortise

### 3.) Jones Fx

- Avulsion fx of the base of the fifth metatarsal

### 4.) Gout

- Hereditary form of arthritis in which uric acid is deposited in joints

### 5.) Osgood-Schlatter Disease

- Incomplete separation or avulsion of the tibial tuberosity

### 6.) Giant Cell Tumor

- Osteoclastoma
- Lucent lesion in the metaphysis usually at the distal femur

### 7.) Chondromalacia Patellae

- Runner's knee
- Softening of the cartilage under the patella

### 8.) Joint Effusion

- Accumulation of fluid in the joint cavity

### 9.) Lisfranc Injury

- Abnormal separation in the base of 1<sup>st</sup> & 2<sup>nd</sup> metatarsal & cuneiform

### 10.) Reiter Syndrome

- Erosions of sacroiliac joints & lower limbs

### 11.) Hallux Valgus

- Congenital abnormality of hallux
- Lateral deviation of great toe

## ROUTINE

### 1.) Bony Injuries – AP, APO & Lateral

### 2.) Bony Pathology – AP & APO

### 3.) Foreign Body Localization – AP & Lateral

## DIVISIONS OF FOOT

- 1.) **Hindfoot** – calcaneus & talus
- 2.) **Midfoot** – cuboid, navicular & cuneiform
- 3.) **Forefoot** – metatarsals & phalanges

## A.) TOES

### AP/AP AXIAL PROJECTION

**PP:** Supine/Seated; knee flexed; 15° foam wedge under foot

**RP:** 3<sup>rd</sup> MTP joint

**CR:** ⊥ or 15° posteriorly

**SS:** Phalanges & distal portion of metatarsals

**AP Axial (15°):** Open IP joints & reduces shortening

### PA PROJECTION

**PP:** Prone (IP joints // to CR); dorsal aspect against IR

**RP:** 3<sup>rd</sup> MTP joint

**CR:** ⊥

**SS:** IP joint spaces are well visualized

### AP OBLIQUE PROJECTION

#### Medial Rotation

**PP:** Supine/seated; knee flexed; lower leg & foot rotated medially 30-45°;

**RP:** 3<sup>rd</sup> MTP joint

**CR:** ⊥

**SS:** 2<sup>nd</sup>-5<sup>th</sup> MTP joint spaces; 1<sup>st</sup>-3<sup>rd</sup> toes

#### Lateral Rotation

**PP:** Supine/seated; knee flexed; lower leg & foot rotated medially 30-45°;

**RP:** 3<sup>rd</sup> MTP joint

**CR:** ⊥

**SS:** 3<sup>rd</sup>-5<sup>th</sup> toes

### LATERAL PROJECTION

**PP:** Lateral recumbent; toe in true lateral

**RP:** IP joint (1<sup>st</sup> toe); proximal IP joint (2<sup>nd</sup>-4<sup>th</sup> toes)

**CR:** ⊥

**SS:** Phalanges in profile; open IP joints spaces

# LOWER EXTREMITIES

## B.) SESAMOIDS

### LEWIS METHOD

#### TANGENTIAL PROJECTION

**PP:** Prone; dorsiflex great toe; ankle elevated; ball of foot  $\perp$  IR

**RP:** 1<sup>st</sup> MTP joint

**CR:** Perpendicular

**SS:** MT head & sesamoids in profile

### HOLLY METHOD

#### TANGENTIAL PROJECTION

**PP:** Seated; plantar 75° to IR; toe flexed & hold w/ strip gauze bandage; foot medial border  $\perp$  to IR

**RP:** 1<sup>st</sup> MTP head

**CR:**  $\perp$

**SS:** MT head & sesamoids in profile

### CAUSTON METHOD

#### TANGENTIAL PROJECTION

**PP:** Lateral recumbent; patient lie against unaffected side; limb partially extended; foot in lateral position; 1<sup>st</sup> MTP joint  $\perp$  to IR

**RP:** Prominence of 1<sup>st</sup> MTP joint

**CR:** 40° toward the heel

**SS:** Sesamoids with slight overlap

## C.) FOOT

### AP/AP AXIAL PROJECTION

**PP:** Supine; knee flexed; plantar surface against IR

**RP:** 3<sup>rd</sup> MTP base

**CR:**  $\perp$  or 10° posteriorly

**SS:** MT & Tarsal ( $\perp$ ); TMT joint (10°)

**ER:**

- For localizing foreign bodies
- Location of fragments in fx of metatarsals & anterior tarsals
- General surveys of the foot

**10° Angulation:** reduces foreshortening of metatarsals

### AP OBLIQUE PROJECTION

#### Medial Rotation

**PP:** Supine; knee flexed; leg rotated medially; plantar surface of foot 30° to IR

**RP:** 3<sup>rd</sup> MTP base

**CR:**  $\perp$

**SS:**

- Cuboid
- Interspaces on lateral side of foot
- Sinus tarsi
- Lateral cuneiform
- 3<sup>rd</sup>-5<sup>th</sup> MT bases
- 5<sup>th</sup> MT tuberosity

#### Lateral Rotation

**PP:** Supine; knee flexed; leg rotated laterally; plantar surface of foot 30° to IR

**RP:** 3<sup>rd</sup> MTP base

**CR:**  $\perp$

**SS:**

- Navicular
- Interspaces on medial side of foot
- Medial & intermediate cuneiform
- 1<sup>st</sup>-2<sup>nd</sup> MT bases

### LATERAL PROJECTION

#### Mediolateral

**PP:** Dorsiflex foot ( $\perp$  to lower leg); leg & foot in lateral position; lateral side of foot against IR (more comfortable)

**RP:** 3<sup>rd</sup> MT base

**CR:** Perpendicular

**SS:** Entire foot in profile

**ER:**

- For localizing foreign body
- Degree of anterior & posterior displacement of fx

#### Lateromedial

**PP:** LPO/RPO; medial surface against IR; plantar surface of foot  $\perp$  to IR

**RP:** 3<sup>rd</sup> MTP base

**CR:** Perpendicular

# LOWER EXTREMITIES

**SS:** True lateral projection of foot

## WEIGHT-BEARING METHOD

### LATERAL PROJECTION

**PP:** Upright; feet elevated (use blocks); IR b/n feet; weight equally distributed on each foot

**RP:** Point above 3<sup>rd</sup> MTP base

**CR:** Horizontal

**SS:** Status of longitudinal arch (pes planus);

Bohler's critical angle (20-40°)

**Bohler's Critical Angle:** angle b/n superior apex of mid-calcaneus to anterior process of calcaneus

## WEIGHT-BEARING METHOD

### AP AXIAL PROJECTION

**PP:** Upright; both feet against IR; weight equally distributed on each foot

**RP:** b/n feet at 3<sup>rd</sup> MTP base level

**CR:** 10° or 15° posteriorly

**SS:** Accurate evaluation & comparison of MT & tarsals

- Hallux valgus & lishfranc injury

## WEIGHT-BEARING COMPOSITE METHOD

### AP AXIAL PROJECTION

**PP:** Upright; 2 exposures

- **First Exposure:** opposite foot step backward (for forefoot); tube in front
- **Second Exposure:** opposite foot step backward (for hindfoot); tube behind

**RP:** 3<sup>rd</sup> MTP base (1<sup>st</sup> exposure); level of lateral malleolus (2<sup>nd</sup> exposure)

**CR:** 15° posteriorly (1<sup>st</sup> exposure); 25° anteriorly (2<sup>nd</sup> exposure)

**SS:** Full outline of the foot

## D.) CONGENITAL CLUBFOOT

### KITE METHOD

#### AP PROJECTION

**PP:** Supine; hips & knees flexed; foot flat on IR; ankles slightly extended; legs are vertical

**RP:** Tarsals

**CR:** 15° posteriorly

**SS:**

- True relationship of bones & ossification centers of tarsals
- Degree of forefoot adduction & calcaneus inversion

**15° Angulation:** places CR ⊥ to tarsals

### KITE METHOD

#### LATERAL PROJECTION

#### Mediolateral

**PP:** Lateral recumbent; uppermost limb flexed & draw forward

**RP:** Midtarsal area

**CR:** Perpendicular

**SS:**

- Anterior talar subluxation
- Degree of plantar flexion (equinus)

### KANDEL METHOD

#### DORSOPLANTAR AXIAL PROJECTION

**PP:** Bending forward position; plantar surface against IR

**RP:** Lower leg

**CR:** 40° anteriorly

**SS:** Calcaneus

**Freiberger-Hersh-Harrison:** CR 35°, 45° & 55° for demonstration of sustentaculum talar joint

### E.) CALCANEUS

#### AXIAL PROJECTION

#### Plantodorsal

**PP:** Supine/Seated; leg fully extended; dorsiflex foot w/ strip of gauze; foot ⊥ to IR

**RP:** 3<sup>rd</sup> MT base

**CR:** 40° cephalad

**SS:** Calcaneus & subtalar joint

#### Dorsoplantar

**PP:** Prone; ankle elevated; dorsiflex ankle; foot ⊥ to IR; IR vertical

# LOWER EXTREMITIES

**RP:** Dorsal surface of ankle joint

**CR:** 40° caudad

**SS:** Calcaneus, subtalar joint & sustentaculum tali

## LILIENTFELD METHOD

### WEIGHT-BEARING COALITION

#### DORSOPLANTAR AXIAL PROJECTION

**PP:** Upright; posterior surface of heel at edge of IR; opposite foot one step forward

**RP:** Level of 5<sup>th</sup> MT base

**CR:** 45° anteriorly

**SS:** Calcaneotalar coaliation

## LATERAL PROJECTION

### Mediolateral

**PP:** Supine; patient turn toward affected side; plantar surface // to IR

**RP:** 1 in distal to medial malleolus

**CR:** ⊥

**SS:** Calcaneus & ankle joint

## WEIGHT BEARING METHOD

### LATEROMEDIAL OBLIQUE PROJECTION

**PP:** Upright; leg perpendicular to IR; calcaneus center to IR

**RP:** Lateral malleolus

**CR:** 45° caudad (medially)

**SS:** Calcaneal tuberosity

**ER:** Useful in diagnosing stress fractures of calcaneus or tuberosity

## F.) SUBTALAR JOINT

### ISHERWOOD METHOD

#### LATEROMEDIAL OBLIQUE PROJECTION

##### Medial Rotation Foot

**PP:** Semisupine; foot & leg rotated 45° medially; knee flexed

**RP:** 1 in. distal & 1 in. anterior to lateral malleolus

**CR:** ⊥

**SS:** Anterior subtalar articulation

### ISHERWOOD METHOD

#### AP AXIAL OBLIQUE PROJECTION

##### Medial Rotation Ankle

**PP:** Seated or semi-lateral recumbent (more comfortable); leg, foot & ankle rotated 30° medially; dorsiflex foot

**RP:** 1 in. distal & 1 in. anterior to lateral malleolus

**CR:** 10° cephalad

**SS:** Middle subtalar articulation & “end on” projection of sinus tarsi

##### Lateral Rotation Ankle

**PP:** Supine/seated; leg, foot & ankle rotated 30° laterally; dorsiflex foot

**RP:** 1 in. distal medial malleolus

**CR:** 10° cephalad

**SS:** Posterior subtalar articulation

### BRODEN METHOD

#### AP AXIAL OBLIQUE PROJECTION

##### Medial Rotation

**PP:** Supine; leg & foot rotated 45° medially; dorsiflex foot; foot rested against 45° foam wedge

**RP:** 2-3 cm to lateral malleolus

**CR:** 10°, 20°, 30° or 40° cephalad

**SS:** Posterior articulation

- Anterior portion (40°)
- Posterior portion (10°)
- Talus & sustentaculum tali articulation (20-30°)

##### Lateral Rotation

**PP:** Supine; leg & foot rotated 45° laterally; dorsiflex foot; foot rested against 45° foam wedge

**RP:** 2 cm distal & 2 cm anterior to medial malleolus

**CR:** 15° cephalad

**SS:** Posterior articulation

**ER:** To determine the presence of joint involvement in cases of comminuted fx

# LOWER EXTREMITIES

## G.) ANKLE

### AP PROJECTION

**PP:** Supine; leg & foot vertical & rotated 5° medially (places malleoli equidistant)  
**RP:** Point midway between malleoli

**CR:** ⊥ to ankle joint  
**SS:** Ankle joint & tibiotalar joint space

### LATERAL PROJECTION

#### Mediolateral

**PP:** Semisupine; lateral surface of foot against IR; dorsiflex foot

**RP:** Medial malleolus

**CR:** ⊥ to ankle joint

**SS:** True lateral projection of lower third of tibia & fibula, ankle joint & tarsals

- 5<sup>th</sup> metatarsal base (identify Jones fx)

#### Lateromedial

**PP:** Semisupine; medial surface of foot against IR; dorsiflex foot

**RP:** 0.5 in. superior to lateral malleolus

**CR:** ⊥ to ankle joint

**SS:** Lateral projection of lower third of tibia & fibula, ankle joint & tarsals

### AP OBLIQUE PROJECTION

#### Medial Rotation

**PP:** Supine;

- Leg & foot rotated 45° medially; dorsiflex foot – to demonstrate bony structure
- Leg & foot rotated 15-20° medially; intermalleolar line // to IR – to demonstrate mortise joint

**RP:** Point midway b/n malleoli

**CR:** ⊥ to ankle joint

**SS:** Distal ends of tibia, fibula & talus; tibiofibular articulation; mortise joints

#### Lateral Rotation

**PP:** Supine; leg & foot rotated 45° laterally; dorsiflex foot

**RP:** Point midway b/n malleoli

**CR:** ⊥ to ankle joint

**SS:** Superior aspect of calcaneus

**ER:** Useful in determining fxs

### STRESS METHOD

#### AP PROJECTION

**PP:** Seated; foot forcibly turned toward the opposite side; inversion & eversion stress to joint

**RP:** Ankle joint

**CR:** ⊥

**ER:** To evaluate the presence of ligamentous tear & joint separation

### WEIGHT-BEARING METHOD

#### AP PROJECTION

**PP:** Upright; heels against the IR; IR vertical; toes pointing toward the x-ray tube

**RP:** Midway at level of ankle joint

**CR:** Horizontal

**ER:** Identify ankle joint space narrowing; side-to-side comparison of joint

## H.) LEG

### AP PROJECTION

**PP:** Supine; femoral condyles // to IR; foot in vertical position;

**RP:** Midshaft

**CR:** ⊥

**SS:** Tibia & fibula; ankle & knee joints

### LATERAL PROJECTION

#### MEDIOLATERAL

**PP:** Supine; RPO/LPO; patella ⊥ to IR; femoral condyles ⊥ to IR;

**RP:** Midshaft

**CR:** ⊥

**SS:** Tibia & fibula; ankle & knee joints

### AP OBLIQUE PROJECTION

**PP:** Supine; leg & foot rotated 45° medially or laterally

# LOWER EXTREMITIES

**RP:** Midshaft

**CR:**  $\perp$

**SS:** Tibia & fibula; ankle & knee joints

- Perpendicular (19-24 cm)

- 3-5° cephalad ( $>24$  cm)

**SS:** Proximal tibiofibular joint; fibular head

## Lateral Rotation

**PP:** Supine; leg rotated 45° medially; hip of unaffected side elevated

**RP:** 0.5 in. inferior to patellar apex

**CR:** 5° cephalad

**SS:** Tibial plateaus; medial femoral & tibial condyles

## WEIGHT-BEARING METHOD

### AP BILATERAL PROJECTION

#### LEACH-GREGG-SIBER

**PP:** Upright; knee fully extended; weight equally distributed on both feet; IR vertical

**RP:** 0.5 in. inferior to patellar apex

**CR:** Horizontal

**SS:** Knee joint spaces

**ER:**

- To reveal narrowing of knee joint space
- To evaluate varus & valgus deformities & degenerative joint disease

## ROSENBERG METHOD

### PA WEIGHT-BEARING

#### STANDING FLEXION

**PP:** Upright; facing vertical IR; anterior surface of flexed knee against IR; femur 45° to IR

**RP:** 0.5 in. inferior to patellar apex

**CR:** Horizontal or 10° caudad

**ER:** Useful for evaluating joint space narrowing & demonstrating articular cartilage disease

## LATERAL PROJECTION

### Mediolateral

**PP:** Lateral recumbent; knee flexed 20-30° (relax muscle & shows maximum volume of joint cavity) or flexed  $<10$ ° (for new or unhealed patellar fx); femoral epicondyles  $\perp$  to IR

**RP:** 1 in. distal to medial epicondyle

**CR:** 5-7° cephalad

**SS:** Knee joint space

## AP OBLIQUE PROJECTION

### Medial Rotation

**PP:** Supine; leg rotated 45° medially; hip of affected side elevated

**RP:** 0.5 in. inferior to patellar apex

**CR:** depending on the measurement b/n ASIS & table top

- 3-5° caudad ( $<19$  cm)

## J.) INTERCONDYLAR FOSSA

### HOLMBLAD METHOD

#### PA AXIAL PROJECTION

#### TUNNEL VIEW

**PP:** Anterior surface of knee against IR; knee 60-70° from IR (20° difference from CR)

**3 positions:**

# LOWER EXTREMITIES

- Standing; knee flexed & rested on a stool
- Standing at side of table; knee flexed & rested over the IR
- Kneeling on table; knee over the IR (Holmlad Method)

**RP:** Popteal depression

**CR:**  $\perp$

**SS:** Intercondylar fossa

## CAMP-COVENTRY METHOD

### PA AXIAL PROJECTION

**PP:** Prone; knee flexed 40-50° from IR; femur against IR; with support under foot

**RP:** Popteal depression

**CR:** 40° (knee flexed 40°) or 50° (knee flexed 50°) caudally

**SS:** Intercondylar fossa

**ER:**

- To detect loose bodies “joint mice”
- To evaluate split & displaced cartilage in osteochoditis
- To evaluate flattening or underdevelopment of lateral femoral condyles in congenital slipped patella

## BECLERE METHOD

### AP AXIAL PROJECTION

**PP:** Supine; knee flexed; femur 60° to long axis of tibia; curved cassette is used

**RP:** 0.5 in. inferior to patellar apex

**CR:**  $\perp$  to long axis of lower leg

**SS:** Intercondylar fossa, intercondylar eminence, knee joint & tibial plateau

## K.) PATELLA

### PA PROJECTION

**PP:** Prone; heel 5-10° laterally (places patella // to IR)

**RP:** Midpopliteal depression

**CR:** Perpendicular

**SS:** Sharper image of patella (closer OID)

### LATERAL PROJECTION

**PP:** Lateral recumbent; unaffected knee & hip flexed; unaffected foot in front; affected knee flexed 5-10° or flexed not >10 (for new or unhealed patellar fx); femoral epicondyles & patella  $\perp$  to IR;

**RP:** Midpatellofemoral joint

**CR:**  $\perp$

**SS:** Patella & patellofemoral joint space

### PA OBLIQUE PROJECTION

#### Medial Rotation

**PP:** Prone; knee flexed 5-10°; knee 45-55° medially

**RP:** Patella

**CR:**  $\perp$

**SS:** Medial portion of patella free of femur

#### Lateral Rotation

**PP:** Prone; knee flexed 5-10°; knee 45-55° laterally

**RP:** Patella

**CR:**  $\perp$

**SS:** Lateral portion of patella free of femur

## KUCHENDORF METHOD

### PA AXIAL OBLIQUE PROJECTION

#### Lateral Rotation

**PP:** Prone; hip elevated 2-3 in.; knee flexed 10° (relax the muscles); knee rotated 35-40° laterally

**RP:** Joint space b/n patella & femoral condyles

**CR:** 25-30° caudad

**SS:** Oblique patella free superimposition of femur

## HUGHSTON METHOD

### TANGENTIAL PROJECTION

**PP:** Prone; anterior surface of knee against IR; knee flexed 50-60°; foot rested against collimator/support

**RP:** Patellofemoral joint

**CR:** 45° cephalad

**SS:** Patella; patellofemoral joint

**ER:**

- To demonstrate subluxation of patella & patellar fx

# LOWER EXTREMITIES

- It allows assessment of femoral condyles

## MERCHANT METHOD

### TANGENTIAL PROJECTION

**PP:** Supine; both knee flexed 40° or b/n 30-90° (to demonstrate various patellar disorders); IR resting on patient's shins; uses IR holding device & axial viewer device

**RP:** Midway b/n patellae at level of patellofemoral joint

**CR:** 30° caudad from horizontal

**SS:** Femoral condyle; intercondylar sulcus & magnified nondistorted patellae

## SETTEGAST METHOD

### TANGENTIAL PROJECTION

**Disadvantage:** Extreme flexion

**PP:** Supine or prone (preferable); knee acutely flexed until patella ⊥ to IR; loop bandage around ankle or foot to hold the leg in position

**RP:** Joint space b/n patella & femoral condyles

**CR:** Perpendicular (if joint is ⊥); 15-20° cephalad (if joint isn't ⊥)

- Angulation depends on knee flexion

**SS:** Patella; patellofemoral joint

**ER:**

- Useful for demonstrating vertical & transverse fx of patella
- Useful for investigating articulating surfaces of patellofemoral articulation

## SUNRISE METHOD

### TANGENTIAL PROJECTION

#### MOUNTAIN/SKYLINE VIEW

**PP:** Supine/Sitting; knee flexed 40-45°

**RP:** Patellofemoral joint

**CR:** 30° from horizontal

**ER:** Joint space b/n patella & femoral condyles

## L.) FEMUR

### AP PROJECTION

**PP:** Supine

- **Distal femur (knee included):** leg rotated 5° inward (places limb in true anatomic position)
- **Proximal femur (hip included):** leg rotated 10-15° inward (places femoral neck in profile)

**RP:** Midfemur

**CR:** ⊥

**SS:** Femoral neck & hip joint (10-15°); knee joint (5°)

### LATERAL PROJECTION

#### Mediolateral

**PP:** Lateral recumbent; affected side against IR

- **Distal femur (knee included):** unaffected limb draw forward; pelvis in true lateral position; affected knee flexed 45°; femoral epicondyles ⊥ to IR;
- **Proximal femur (hip included):** unaffected limb draw posteriorly; pelvis rolled 10-15° posteriorly

**RP:** Midfemur

**CR:** ⊥

**SS:** ¾ of femur & adjacent joints

### TRANSLATERAL PROJECTION

#### CROSSTABLE LATERAL

**PP:** Dorsal decubitus; IR placed vertically against medial/lateral surface of femur;

**RP:** Medial side of midfemur

**CR:** Horizontal

**SS:** Entire femur & knee joint

**ER:** For patient who can't tolerate routine lateral position because of fractures or destructive disease

☺ THE END ☺

*"BOARD EXAM is a matter of PREPARATION. If you FAIL to prepare, you PREPARE to fail"*

03/24/14